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(54) Title: TERMITICIDE COMPOSITIONS

(57) Abstract: Termicidal compositions comprising bifenthrin and acetamiprid are disclosed. The compositions provide a combination of properties not exhibited by either active ingredient when used alone.

TERMITICIDE COMPOSITIONS

The present invention relates generally to pesticidal compositions. In particular, it pertains to compositions useful for control of soil-borne termites.

BACKGROUND OF THE INVENTION

Termites are undisputedly the most destructive of all structural insects. Termites are estimated to cause 1.5 billion dollars of damage to structures annually, and an additional one billion dollars is spent on treatment. Depending on the type of termite, a colony can cover as much as 22,000 square feet. These industrious insects work 24 hours a day, gradually eating wood and any other cellulose containing material in their environment. Since they remain hidden within the wood in which they are feeding, in mud tubes, or in the soil, they typically wreak havoc undetected. There are two types of termites, described as i) dry wood termites, and ii) subterranean termites. Of these two types, the subterranean termites usually live in the soil (i.e., soil-borne), from which they build mud tubes to structural wood where they then feed.

Control of soil-borne termites can be accomplished by strategic application of a termiticide to the soil where there is a termite infestation, to provide a continuous chemical barrier in the soil surrounding and beneath a structure. However, the final distribution of a liquid termiticide in soil is the result of a whole series of variables: soil moisture, soil type, solubility of the active ingredient in water, formulation type, and application variables such as volume applied, pressure and nozzle type. A standard method for placing the termiticide in the soil is by physical means, a method that may, or may not be totally reliable for reasons set forth above. Such physical means include, *inter alia*, (1) the digging of trenches around the outside of a structure, then flooding the trenches with termiticide, or (2) by injecting the termiticide directly into the soil using a mechanical device, such as a soil rod. These methods are very labor-intensive, and require an inordinate amount of termiticide to be effective. Another method for control of soil-borne termites is by the application of a termiticide directly to the surface of soil, thereby

in theory creating a chemical barrier in the soil when the termiticide leaches into the soil. Termiticides having potential utility in application directly to the surface of soil are in the form of a liquid termiticide. A liquid termiticide is defined as a formulation containing at least one termiticide where the formulation is dispensed in an aqueous medium prior to its application to a locus where termite control is needed. Examples of formulations that can be dispensed in aqueous medium to provide a liquid termiticide include, without limitation, formulations of the termiticide bifenthrin, sold by FMC Corporation under the names and trademarks of Talstar® GC Flowable Insecticide/Miticide, or Talstar® Termiticide/Insecticide. However, the termiticide in most liquid termiticides prepared from these formulations are not particularly mobile in the soil. That is to say, the termiticide does not appreciably spread downwardly and laterally from its point of application on the surface of the soil. Reasons for the immobility of such termiticides in liquid termiticides when placed on the soil include, *inter alia*, (1) the limited water solubility of the termiticide, for example, of about 3 parts per million (ppm) or less, and (2) the tendency of the termiticide to bind to the soil. Consequently when a liquid termiticide containing such relatively water-insoluble, soil-binding termiticides are applied to the soil, there may be gaps, or thinly treated areas, in the desired continuous chemical barrier caused by the immobility of the termiticide in the soil. Termites, therefore, can gain access to food sources/structures through gaps and thinly treated areas in the chemical barrier. One advantage to certain liquid termiticides of this type, such as bifenthrin, is that they are repellent to termites.

Other liquid termiticides, for example, acetamiprid are not repellent to termites, but are more water-soluble and consequently have higher soil mobility. These types of liquid termiticides are shorter lived, but can inflict high mortality to the termite population relatively quickly.

Hence, it would be advantageous to provide a continuous chemical barrier to termites that has long lasting termite repellency coupled with a shorter-term ability to provide high mortality to termites.

SUMMARY OF THE INVENTION

It has now been unexpectedly found that application of a termiticide composition containing a mixture of two termiticides, i.e., bifenthrin and acetamiprid, results in a continuous chemical barrier which provides both a long lasting termite repellent component and a fast acting termite killing component. It has also been found that application of a combination of bifenthrin and acetamiprid to an area infested by termites results in unexpectedly improved control of the termites as compared to the results with either of these materials alone.

DETAILED DESCRIPTION OF THE INVENTION

It has now been unexpectedly found that application of a liquid termiticide composition containing bifenthrin and acetamiprid, results in a continuous chemical barrier which provides both a long lasting termite repellent component and a fast acting termite killing component as well as more effective elimination of termites in the area to which the combination is applied. The amount of bifenthrin in the combination should be equal to from about 0.0001 to about 0.3 percent by weight and the amount of acetamiprid should be equal to from about 0.0001 to about 0.3 percent. All percents are percent by weight based on the total weight of the composition. Preferred results are achieved with an amount of bifenthrin equal to from 0.001 to 0.06 percent and an amount of acetamiprid equal to from 0.01 to 0.1 percent. An especially preferred termiticide composition of the present invention is comprised of 0.03% by weight to 0.06% by weight of bifenthrin and 0.0125% by weight to 0.1% by weight of acetamiprid.

As set forth above, a liquid termiticide is any formulation containing a termiticide where the formulation is dispensed in an aqueous medium prior to its application to a locus where termite control is needed. That is to say, a liquid termiticide is made up of 1) a formulation of a termiticide, and 2) an aqueous medium. There may be more than one formulation for a particular termiticide, depending upon how that termiticide is to be used to control termites. The compositions of the present invention may be derived from commercially available formulations of termiticides. All such formulations of termiticides that are

dispensed in an aqueous medium prior to application are, therefore, within the scope of the present invention. Formulations of bifenthrin which are particularly useful are set forth below:

Examples of Bifenthrin Formulations From Which a Liquid Termiticide May be Derived by Dispensing into an Aqueous Medium	Termiticide In Formulation	Manufactured By:
Talstar® Termiticide/Insecticide	Bifenthrin	FMC Corporation
Talstar® GC Flowable Insecticide/Miticide	Bifenthrin	FMC Corporation

Formulations of acetamiprid that are particularly useful in the context of the present invention include, without limitation, acetamiprid (sold under the name and trademark of INTRUDER), sold as a 70% wettable powder.

Using methods known to those skilled in the art, the formulations of termiticides are dispersed in an aqueous medium to provide a composition containing a termiticidally effective amount of a termiticide.

The following examples further illustrate the present invention, but, of course, should not be construed as in any way limiting its scope. The examples set forth certain biological data illustrating the efficacy of the compositions of the present invention in controlling termites. Unless otherwise indicated, all parts, percentages, and the like are by weight.

EXAMPLE 1
Test to Determine Termite Mortality by Soil Applications of Combinations of Bifenthrin and Acetamiprid

The compositions of the present invention were tested for termiticide activity in the following manner:

Test compositions made up of Talstar® Termiticide/Insecticide and a 70% wettable powder of acetamiprid in distilled water were prepared that provided

appropriate rates of application of combinations of bifenthrin and acetamiprid, as well as bifenthrin and acetamiprid alone.

Glass tubing, 13 mm in diameter, was then cut into 20 cm sections in sufficient quantity to conduct the test. Each 20 mm section of tubing was marked at 5 cm, 8 cm, and 18 cm distances from one end of the tube designated as the bottom. Each section of tubing was packed with a sandy soil (3% wt/wt moisture content) by first placing a section of a 1 cm diameter wooden dowel into the bottom of the glass tube up to the 8 cm marking, then introducing approximately 2 cm of soil into the other end of the tube designated as the top. The soil was then gently packed into the tube from the top using a second section of the 1 cm diameter wooden dowel. The process was repeated using 2 cm aliquots of soil until the soil level was adjacent to the 18 cm marking, thereby providing a column of soil 10 cm in height. An agar plug, which was formed in a section of the 13 mm diameter glass tubing of the type used to conduct these tests, was cut into 3 cm sections. A 3 cm section of agar was then gently pushed into the bottom of each tube containing the soil until the agar plug firmly touched the soil at the 8 cm marking, thereby creating a 5 cm void in the bottom of each section of tubing. Following placement of the agar plugs in each section of tubing; two sections of applicator sticks cut in 6 cm lengths were inserted into the bottom end of each tube thereby forcing about 1 cm of each stick into the agar plug to hold the agar plug in place. Plastic caps, with an inside diameter of 13 mm and holes drilled in their centers, were placed on the bottom ends of each of the sections of tubing. A sharpened applicator stick was then inserted into the hole in each plastic cap through the agar plug to the intersection of the agar plug and the soil. The applicator stick was then gently removed in a rotating manner to provide a means for a free flow of liquid through the soil. Each section of tubing was then stood upright, and 0.5 mL aliquots of each suspension of bifenthrin, acetamiprid or combinations thereof , as prepared above, were pipetted onto the top of the soil. Upon application of the test suspensions the top of each section of tubing was covered with a small piece of aluminum foil. The tubes were then allowed to stand for about 20 hours to allow movement of the termiticide(s) downward into the soil.

After this time a plastic cap of 13 mm inside diameter was placed on the top of each section of tubing. The plastic caps with the holes drilled in their centers were removed from the bottom of each section of tubing, and a piece of 0.5 cm x 4 cm filter paper was then placed between the two sections of applicator sticks. Fifty termite (*Reticulitermes flavipes*) workers were then inserted into the 5 cm void in the bottom of each section of tubing. New plastic caps without holes drilled in their centers were placed on the bottom of each section of tubing. The sections of tubing were then stored in an upright position, with the termites located below the soil. At 1, 3, 6, 8, 10, 13, 15, 17, 20, and 22 days after treatment (DAT), termite mortality was measured. The following results were obtained:

Table 1
Control of Termites by Soil Application of Bifenthrin and Acetamiprid Combinations

	Percent Mortality									
Treatment	1 DAT	3 DAT	6 DAT	8 DAT	10 DAT	13 DAT	15 DAT	17 DAT	20 DAT	22 DAT
Bifenthrin @ 60 ppm	6	6	11	13	13	13	16	16	16	16
Acetamiprid @ 500 ppm	5	84	100	100	100	100	100	100	100	100
Bifenthrin @ 60 ppm + Acetamiprid @ 500 ppm	5	52	100	100	100	100	100	100	100	100
Bifenthrin @ 60 ppm + Acetamiprid @ 250 ppm	6	21	90	90	90	90	90	90	90	90
Bifenthrin @ 60 ppm + Acetamiprid @ 100 ppm	7	20	88	88	88	100	100	100	100	100
Bifenthrin @ 60 ppm + Acetamiprid @ 25 ppm	5	31	84	96	88	88	88	88	88	88
Bifenthrin @ 60 ppm + Acetamiprid @ 10 ppm	1	31	60	62	63	78	80	80	80	80
Untreated	0	0	0	0	0	0	0	0	0	0

DAT is Days After Treatment

EXAMPLE 2
Test to Determine Termite Mortality by Direct Application of Combinations of Bifenthrin and Acetamiprid to Termites

The compositions of the present invention were tested for termiticide activity in the following manner:

Test compositions made up of Talstar® Termiticide/Insecticide and a 70% wettable powder of acetamiprid in distilled water were prepared that provided appropriate rates of application of combinations of bifenthrin and acetamiprid, as well as bifenthrin and acetamiprid alone.

Solutions of the test materials were applied directly to 50 termites (*Reticulitermes flavipes*) per petri plate using a track sprayer calibrated to deliver 1.2 ml per petri plate at 40 psi. After application, petri dishes with treated termites were inverted onto fresh petri plates containing dry filter paper. After all applications were completed, termites were then transferred to petri dishes containing moist soil with cardboard as a food source. Expired termites were removed at each reading. At 0 hours, 1 hour, 2 hours, 1 day, and 2 days after treatment (HAT or DAT, respectively), termite mortality was measured. The following calculation determined whether the combination treatments provided enhanced activity over what would be expected based on the activity of each active ingredient separately:

$$\left(\frac{\text{Percent Mortality of A}}{100} + \left(\frac{100 - \text{Percent Mortality of A}}{100} * \frac{\text{Percent Mortality of B}}{100}\right)\right) * 100$$

A and B refer to the two separate treatments of two different active ingredients at specific rates.

Table 2
Control of Termites by Direct Application of Bifenthrin and Acetamiprid Combinations

Treatment	Percent Mortality				
	0 HAT	1 HAT	2 HAT	1 DAT	2 DAT
Bifenthrin @ 10 ppm	0	0	0	11	26
Bifenthrin @ 50 ppm	0	0	0	63	96
Acetamiprid @ 100 ppm	0	0	0	16	78
Acetamiprid @ 200 ppm	0	0	0	35	88
Bifenthrin @ 10 ppm + Acetamiprid @ 100 ppm	0	0	0	76 *	99 *
Bifenthrin @ 10 ppm + Acetamiprid @ 200 ppm	0	0	0	78 *	100 *
Bifenthrin @ 50 ppm + Acetamiprid @ 100 ppm	0	0	0	93 *	100 *
Bifenthrin @ 50 ppm + Acetamiprid @ 200 ppm	0	0	0	94 *	99 *
Untreated	0	0	0	1	4

HAT is Hours After Treatment

DAT is Days After Treatment
* Combination treatments where enhanced effects were observed above and beyond what would be anticipated based on each active ingredient alone.

In the context of the present invention, the term "termiticide" refers to the active chemical compound or ingredient, such as bifenthrin or acetamiprid, that kills or repels termites. The term "termiticide" refers to a formulation of a termiticide where the formulation can be dispensed in an aqueous medium prior to its application to a locus where termite control is desired. The term "locus" refers to any locations where control of termites is needed or is expected to be needed. Such locations include, without limitation, buildings, trees, posts, poles, fences, and locations adjacent to buildings, trees, posts, poles, fences, as well as other locations. The term "repellency" refers to driving back, warding off, or keeping termites away through the use of a termiticide in a termite barrier. The terms "mortality", "percent mortality", "control", or "percent control" may be used interchangeably, and refer to the killing of and/or repelling of termites.

Those of ordinary skill in the art will appreciate that variations of the invention may be used and that it is intended that the invention may be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications encompassed within the spirit and scope of the invention as defined by the following claims.

What is claimed is:

1. A termiticide composition comprising i) bifenthrin and ii) acetamiprid.

2. A composition according to claim 1, wherein the composition contains from 0.0001% by weight to 0.3% by weight of bifenthrin and from 0.0001% by weight to 0.3% by weight of acetamiprid.

3. A composition according to claim 1, wherein the composition contains from 0.001% by weight to 0.06% by weight of bifenthrin and 0.01% by weight to 0.1% by weight of acetamiprid.

4. A composition according to claim 1, wherein the composition contains from 0.03% by weight to 0.06% by weight of bifenthrin and 0.0125% by weight to 0.1% by weight of acetamiprid.

5. A method for controlling termites, comprising applying a termiticidally effective amount of a composition of claim 1 to a locus where termite control is needed or is expected to be needed.

6. A method according to claim 5, wherein said locus is selected from a termite-infested structure, a structure that is expected to be termite-infested, or a location adjacent to said structures.